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A checklist of spiders from the herbaceous layer of a coastal dune forest ecosystem at Richards Bay, KwaZulu-Natal, South Africa (Arachnida: Araneae)

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ABSTRACT

Coastal dune forest covers approximately 1% of the land area of KwaZulu-Natal, South Africa. It is a habitat type seriously threatened from human population pressure and development. During 1995, spiders were sampled from the herbaceous layer of coastal dune forests at Richards Bay, KwaZulu-Natal, using sweep nets. Four stands were sampled in rehabilitating dune forest and one stand in a mature forest. Although samples were taken for a two-month period only, a total of 2955 spiders representing 23 families, 72 genera and 96 species were recorded. Four families represented 87% of all spiders collected, with Pisauridae being the most abundant representing 30% over all, followed by the Araneidae with 27%, the Tetragnathidae with 16% and the Salticidae with 14%. Wandering spiders (n=689) were represented by 52 species and constituted 23.3% of the total while the remaining 76.7% of the web dwellers (n=2266) were represented by 44 species. This is the first quantitative survey of the spiders from the herbaceous layer of coastal dune forest in South Africa and forms part of the South African National Survey of Arachnida (SANSA).

KEY WORDS: Arachnida, Araneae, spiders, biodiversity, coastal dune forest, South African National Survey of Arachnida.

INTRODUCTION

Conservation biologists are beginning to recognise the importance of the invertebrate component in the functioning of healthy ecosystems. However, meaningful conservation cannot take place if the species involved are not known, or knowledge regarding their ecology and distribution is poorly understood. Although Araneae constitute an abundant and highly successful group of invertebrate animals, little is known about their diversity within most ecosystems in South Africa. Compared with areas of the northern hemisphere, our knowledge of African spiders is particularly weak and is largely restricted to taxonomic studies. Preliminary investigations into the biodiversity of the spider fauna of South Africa have highlighted a lack of knowledge of the taxonomy, ecology and diversity of most groups (Dippenaar-Schoeman & Jocqué 1997). Only 16% of genera occurring in South Africa have been revised recently (Dippenaar-Schoeman 2002). In an effort to address this problem the South African National Survey of Arachnida (SANSA) was initiated in 1997. The main aim of this umbrella project is to describe and make an inventory of the arachnid fauna of South Africa (Dippenaar-Schoeman & Craemer 2000). Thrusts within SANSA are focused on inventories of the arachnid fauna of the different floral biomes, provinces, conserved areas and agro-ecosystems.

Current knowledge of the spider fauna of KwaZulu-Natal, South Africa is chiefly based on *ad hoc* sampling. Published inventories from this province are restricted to surveys undertaken at Kosi Bay (26°52'S:32°52'E) (Lawrence 1937, 1942) and Lake Sibaya (27°20'S:32°40'E) (Lawrence 1968). Data from these two surveys were used to compile the first checklist of the spiders of Maputaland, KwaZulu-Natal (Lawrence *et al*. 1980). A third survey in the Province was undertaken at the Ngome State Forest near Vryheid (22°58'S:30°13'E) in 1992. Five habitat types, including indigenous forest and a pine plantation were sampled using pitfall traps over a one-year period (Van der Merwe 1994; Van der Merwe *et al*. 1996).

In recent decades human-induced changes in the environment and the concomitant effects on species diversity and composition have become a subject of growing concern (Van der Merwe 1994). Such environmental changes took place northeast of Richards Bay when a local mining company, Richards Bay Minerals (RBM), began the extraction of minerals from coastal sand dunes in 1976. The mining operation required the clearing of 14 km^2 of natural dune forest vegetation, with an obviously devastating effect on the indigenous flora and fauna. Rehabilitation of parts of the mined area began in 1977 and has continued to the present day. The rehabilitation process, described by Van Aarde *et al*. (1996), resulted in the formation of a series of known-aged stands of developing coastal dune forest.

In this paper a report is provided on a fourth survey which investigated the spiders of coastal dune forests which were undergoing post-mining rehabilitation at Richards Bay, KwaZulu-Natal. This study represents the first quantitative survey of spiders from the herbaceous layer of coastal dune forest in South Africa and is the result of a two-month intensive collecting period during 1995 in one stand of mature coastal dune forest and in four stands which were being rehabilitated. A checklist of the spiders of the ground layer collected with pitfall traps was reported on by Dippenaar-Schoeman & Wassenaar (2002). Here, a checklist of the spiders collected from the herbaceous layer is presented.

Little is known about spiders from the herbaceous layer in South Africa. The only published surveys of the field layer are those surveys undertaken at Roodeplaat Dam Nature Reserve (Dippenaar-Schoeman *et al*. 1989) and at the Makalali Private Game Reserve in Limpopo Province (Whitmore *et al*. 2001).

MATERIAL AND METHODS

Spiders were sampled from four mined stands being rehabilitated, with median ages of 2-, 8-, 12- and 16-years respectively (Table 1), together with an unmined, relatively undisturbed stand of mature coastal dune forest (*c*.100-years, based on historical aerial photographic evidence at the time of our study). The areas being rehabilitated were established after mining in the Tisand lease area of Richards Bay Minerals, northeast of Richards Bay (28°43'S:32°12'E). The Richards Bay–St Lucia area falls within the Mozambique coastal plain sector of the east coast as classified by Tinley (1985). Topographically, the area is characterised by longitudinal sand dunes, lying parallel to the coastline, and rising to an elevation of between 40 m and 90 m above sea level. The slope angles of the sea-facing dunes are moderately steep to very steep (10°–30°).

Information on climate is sourced from Avis (1992) and Ferreira (1996). Most rain falls during January, February and March, with February usually being the wettest month. The area seldom experiences extended droughts, with rainfall being recorded for about seven months of the year (approximately 30% of annual precipitation occurs in the winter) with a mean annual rainfall of 1292 mm. Daily maximum temperatures range from 22.6°C in June to 30.0°C in January (maximum recorded: 40.8°C). Daily minimum temperatures range from 10°C in June to 20.6°C in January. Frost is not known to occur. Most of the winds blow either north-easterly or south-westerly, parallel to the coast. Wind occurs throughout the year, with the autumn months being the calmest. Mean relative humidity ranges from 59% in August to 72% in April and November.

In general the herbaceous layer consists of a short (0.1 m to <1.0 m) grass-forb layer and a taller shrub layer (1 m to <2 m), except in the oldest, unmined sections where the structure is more diverse. Gross vegetation structure of the different stands is shown in Table 1.

Samples were taken with a sweep net along five 100 m long transects in each of the four regenerating coastal dune forest stands and the one unmined stand, during November and December 1995. The starting points and directions of the transects were random. Each transect was walked twice in opposite directions. At every second step a sweep-sample was taken, alternatively at knee-height (grass-forb or herb layer) and at shoulder-height (shrub layer). Sweeping was directed at vegetation and when no vegetation was present that particular sweep-sample was taken at the following step. Twice per transect, spiders were collected from the sweep net with a paintbrush and stored in a labelled jar containing 70% alcohol.

Material was identified to species level by the first author where possible. Some species could not be identified owing to the unresolved taxonomy of some families in Africa, e.g. Theridiidae and Lycosidae. Furthermore, immature specimens could not always be identified with certainty to species level. Voucher specimens are deposited in the National Collection of Arachnida (NCA), ARC-Plant Protection Research Institute in Pretoria, South Africa.

RESULTS

A total of 2955 spiders representing 23 families, 72 genera and 96 species were recorded. The highest number of species (63%), was recorded from the 2-year stand followed by the 8-year stand with 58% (Table 2). The highest abundance (n=1241) was recorded in the 8-year stand, followed by the 2-year stand (n=789) and 12-year stand (n=724). The lowest numbers were recorded from the 16-year stand (n=81), followed by the old forest with only 120 specimens.

The wandering spiders (689) were represented by 52 species and constituted 23.3% of the total compared to the 44 species of web builders representing 76.7% of the total (Table 2). Orb-web spiders and their derivatives represented by four families: Araneidae (n=792), Deinopidae (n=15), Tetragnathidae (n=470) and Uloboridae (n=50) were the most abundant group, representing 45% of all species collected. They were present at all sites. The araneids, represented by 18 species, were especially abundant in the 8-year stand where they made up 28% of the total (Table 2). Two araneid species, *Caerostris sexcuspidata* (Fabricius, 1793) and *Pararaneus cyrtoscapus* (Pocock, 1898), were the most abundant species overall. Their webs were very abundant, especially in the 2-year and 8-year stands, webs frequently abutting one another (Dippenaar-Schoeman pers. obs.).

Thirty percent of the spiders collected construct sheet-webs and are represented by species of the families Cyatholipidae (n=3), Linyphiidae (n=6) and Pisauridae (n=878). The last mentioned family contains the two most abundant species, *Charminus atomarius*

(Lawrence, 1942) (n=524) and *C. ambiguus* (Lessert, 1925) (n=302) collected during the survey. The pisaurids were more abundant in the 8-year stand (n=338) followed by the 12-year stand (n=277) and 2-year stand (n=246). They were absent from the 12-year stand and only 17 pisaurid spiders were recorded in the old forest. Very little is known regarding the behaviour and prey spectrum of this group of pisaurids. Casual field observations indicate that *C. ambiguus* construct a sheet-like web over the surface of broad-leaved plants. A similar observation was made by Lenler-Eriksen (1969), who observed leaf-dwelling pisaurid species constructing a short tube-like retreat in the curve of the leaf, with the leaf bent slightly downwards and both ends open.

Of the wandering spiders, the Salticidae (n=418) was the most abundant family followed by the Thomisidae (n=64) and Oxyopidae (n=61). The salticid *Thyene aurantianca* (Simon, 1902) was the most abundant species followed by *Oxyopes longispinosus* Lawrence, 1938 (n=47).

DISCUSSION AND CONCLUSION

The high abundance of web dwellers, especially orb web spiders could possibly be explained by the presence of dense *Acacia kosiensis* P.P. Swartz (Fabaceae) cover in the 2-year to 12-year stands ranging in height from 0.7–3.0 m, with dense undergrowth (Table 1). Studies have indicated that the physical structure of the habitat may have a distinct effect on the composition of the spider community (Wise 1993). It provides the necessary support for anchoring webs and also increases the availability of retreat space and modification of the microclimate, which may affect spiders and their prey. According to Uetz (1986), high web densities occur in areas where microhabitat features permit large populations to inhabit small areas due to favourable web attachment conditions. Tolbert (1977) found that many araneids that colonise early successional vegetation produce large numbers of offspring (>1000/female) and disperse by ballooning. During colonisation less emphasis is placed on survival than on colonising of new habitats (Tolbert 1977). This could explain the high number of web dwellers, especially the araneids.

During a pit trap survey of the ground-living spiders from the same area, a total of 49 species was recorded (Dippenaar-Schoeman & Wassenaar 2002). This brings the total number of species recorded from this area to 141. Only 15 species were collected from both the ground and herbaceous layer. This confirms the observation of Russell-Smith (1999) that more than one habitat type of a region requires to be sampled for arachnids, in order to obtain a better insight into species richness and diversity.

With the ecology and diversity of the spider fauna of KwaZulu-Natal so poorly known, this study is a contribution to our knowledge on the spider fauna of the province, as well as geographical distribution of spider species from coastal dune forest. As such it represents new distribution records for all species recorded and possibly new localities of some undescribed species of the families Araneidae, Pholcidae, Theridiidae and Uloboridae.

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TABLE 1

Vegetation types in different-aged stands sampled at Richards Bay, KwaZulu-Natal, South Africa during November & December 1995.

Stand age	**Vegetation type**	**Height of vegetation**	**Understorey**
Rehabilitating coastal dune forest			
2-year	*Acacia kosiensis* shrubland	0.7 m	Percentage vegetation cover below 30 cm is relatively high in open areas (>80%) and low in shrubby areas (<50%)
8-year	*Acacia kosiensis* shrubland	1.5–3 m	Sparse undergrowth and a low percentage ground cover (<40%)
12-year	*Acacia kosiensis* woodland	7–9 m	Moderately thick undergrowth; a high percentage ground cover (>80%)
16-year	*Acacia kosiensis* woodland	9–12 m	Relatively thick undergrowth; a high percentage ground cover (90–100%)
Mature secondary coastal dune forest			
*c.*100-year	Closed canopy with high tree diversity	12–>15 m	Undergrowth patchy; true sub-canopy layer; percentage ground cover is relatively low (<50%)

TABLE 2

Annotated checklist of spiders recorded during a two-month period (November & December 1995), from four mined stands of rehabilitating coastal dune forest (2-, 8-, 12- & 16-year old stands) and one unmined, undisturbed stand (*c.* 100-year old), at Richards Bay, KwaZulu-Natal Province, South Africa. Totals per species are provided in the last column and totals per stand in the last row. Abbreviations: OWB – orb-web, SHWB – sheet-web, SPWB – space-web, W – wanderers, WB – web dwellers.

		Stands (approximate ages)					
Species	**Guilds**	**2-yr**	**8-yr**	**12-yr**	**16-yr**	**100-yr**	**Totals**
ARANEIDAE							
Acusilas africanus Simon, 1895	OWB	2	-	-	-	-	**2**
Araneus holzapfelae Lessert, 1936	OWB	-	1	-	-	3	**4**
Araneus nigroquadratus Lawrence, 1937	OWB	38	26	17	2	2	**85**
Argiope aurocincta Pocock, 1898	OWB	7	11	-	-	-	**18**
Argiope flavipalpis (Lucas, 1858)	OWB	11	9	2	-	-	**22**
Caerostris sexcuspidata (Fabricius, 1793)	OWB	67	175	88	-	3	**333**
Cyclosa insulana (Costa, 1834)	OWB	-	-	1	-	-	**1**
Gasteracantha milvoides Butler, 1873	OWB	7	-	18	-	-	**25**
Isoxya cicatricosa (C.L. Koch, 1844)	OWB	-	-	-	-	1	**1**
Isoxya tabulata (Thorell, 1859)	OWB	8	5	21	-	16	**50**
Lipocrea longissima (Simon, 1881)	OWB	-	-	-	2	-	**2**
Mahembea hewitti Lessert, 1930	OWB	-	-	-	-	1	**1**
Nemoscolus elongatus Lawrence, 1947	OWB	1	-	-	-	-	**1**
Nemoscolus vigintipunctatus Simon, 1897	OWB	3	1	1	-	-	**5**
Neoscona blondeli (Simon, 1885)	OWB	18	-	-	18	-	**36**
Neoscona subfusca (C.L. Koch, 1837)	OWB	4	4	17	8	-	**33**
Pararaneus cyrtoscapus (Pocock, 1898)	OWB	57	112	1	-	-	**170**
Taxa indet. (1)	OWB	1	-	-	-	2	**3**
Totals		**224**	**344**	**166**	**30**	**28**	**792**
CLUBIONIDAE							
Clubiona lawrencei Roewer, 1951	W	3	2	3	-	1	**9**
Clubiona pupillaris Lawrence, 1938	W	-	1	1	-	1	**3**
Totals		**3**	**3**	**4**	-	**2**	**12**

Species	**Guilds**	**2-yr**	**8-yr**	**12-yr**	**16-yr**	**100-yr**	**Totals**
CORINNIDAE							
Austrachelas incertus Lawrence, 1938	W	1	-	-	-	-	**1**
Copa flavoplumosa Simon, 1885	W	1	1	-	1	-	**3**
Trachelas roeweri Lawrence, 1938	W	1	-	-	-	-	**1**
Totals		**3**	**1**	-	**1**	-	**5**
CYATHOLIPIDAE							
Isicabu zuluensis Griswold, 1987	SHWB	-	2	-	-	1	**3**
DEINOPIDAE							
Deinopis cornigera Gerstäcker, 1873	OWB	-	14	1	-	-	**15**
GNAPHOSIDAE							
Aphantaulax signicollis Tucker, 1923	W	-	-	1	1	-	**2**
Xerophaeus bicavus Tucker, 1923	W	1	-	-	-	-	**1**
Totals		**1**	-	**1**	**1**	-	**3**
LINYPHIIDAE							
Taxa indet. (1)	SHWB	-	2	-	-	4	**6**
LIOCRANIDAE							
Taxa indet. (1)	W	-	1	-	-	-	**1**
LYCOSIDAE							
Pardosa sp. (immature)	W	-	-	1	-	1	**2**
Taxa indet. (1)	W	3	3	4	-	1	**11**
Totals		**3**	**3**	**5**	-	**2**	**13**
MIMETIDAE							
Mimetus natalensis Lawrence, 1938	W	-	1	-	-	8	**9**
MITURGIDAE							
Cheiracanthium aculeutum Simon, 1884	W	1	1	-	2	-	**4**
Cheiramiona clavigera (Simon, 1897)	W	5	4	3	-	-	**12**
Cheiramiona filipes (Simon, 1898)	W	1	-	-	-	-	**1**
Cheiramiona silvicola (Lawrence, 1938)	W	8	3	1	-	-	**12**
Totals		**15**	**8**	**4**	**2**	-	**29**
OXYOPIDAE							
Hamataliwa sp. 1 indet.	W	2	-	-	-	1	**3**
Oxyopes hoggi Lessert, 1915	W	1	-	1	-	-	**2**
Oxyopes longispinosus Lawrence, 1938	W	14	28	1	3	1	**47**
Oxyopes vogelsangeri Lessert, 1946	W	-	1	-	-	-	**1**
Oxyopes sp. 1 indet.	W	-	6	-	-	-	**6**
Oxyopes sp. 2 indet.	W	-	1	-	1	-	**2**
Totals		**17**	**36**	**2**	**4**	**2**	**61**
PHOLCIDAE							
Spermophora sp. (immature)	SPWB	-	-	-	-	5	**5**
Micromerys sp. indet.	SPWB	-	-	-	-	3	**3**
Totals		-	-	-	-	**8**	**8**
PHILODROMIDAE							
Philodromus browningi Lawrence, 1952	W	-	-	-	2	-	**2**
Suemus punctatus Lawrence, 1938	W	5	-	1	4	-	**10**
Tibellus flavipes Caporiacco, 1939	W	-	-	1	3	-	**4**
Thanatus sp. (immature)	W	-	-	1	-	-	**1**
Totals		**5**	-	**3**	**9**	-	**17**
PISAURIDAE							
Charminus ambiguus (Lessert, 1925)	SHWB	149	107	41	-	5	**302**
Charminus atomarius (Lawrence, 1942)	SHWB	58	219	236	-	11	**524**
Charminus natalensis (Lawrence, 1947)	SHWB	4	5	-	-	-	**9**
Cispinilus sp. (immature)	SHWB	35	7	-	-	1	**43**
Totals		**246**	**338**	**277**	-	**17**	**878**

Species	**Guilds**	**2-yr**	**8-yr**	**12-yr**	**16-yr**	**100-yr**	**Totals**
SALTICIDAE							
Brancus bevisi Lessert, 1925	W	1	-	-	-	-	**1**
Festucula festuculaeformis (Lessert, 1925)	W	-	-	-	2	-	**2**
Heliophanus debilis Simon, 1901	W	-	4	-	6	-	**10**
Hyllus marleyi Lessert, 1925	W	1	2	1	-	-	**4**
Myrmarachne laurentina Bacelar, 1953	W	-	-	-	-	1	**1**
Thyene inflata (Gerstäcker, 1873)	W	13	2	-	3	3	**21**
Thyene natalii Peckham & Peckham, 1903	W	10	-	1	2	2	**15**
Thyenula aurantiaca (Simon, 1902)	W	76	140	133	1	14	**364**
Totals		**101**	**148**	**135**	**14**	**20**	**418**
SCYTODIDAE							
Scytodes maritima Lawrence, 1938	W	1	-	4	-	-	**5**
SELENOPIDAE							
Anyphops decoratus (Lawrence, 1940)	W	-	1	1	-	1	**3**
SPARASSIDAE							
Olios biarmatus Lessert, 1925	W	6	-	-	-	4	**10**
Olios sp. 1 indet.	W	4	8	4	1	10	**27**
Olios sp. 2 indet.	W	1	2	-	-	-	**3**
Palystes superciliosus L. Koch, 1875	W	2	3	2	-	-	**7**
Panaretella zuluana Lawrence, 1937	W	1	1	-	-	-	**2**
Totals		**14**	**14**	**6**	**1**	**14**	**49**
TETRAGNATHIDAE							
Leucauge decorata (Blackwall, 1864)	OWB	21	63	8	-	-	**92**
Leucauge festiva (Blackwall, 1866)	OWB	37	120	55	13	-	**225**
Leucauge levanderii (Kulzcynski, 1901)	OWB	18	49	8	1	-	**76**
Leucauge medjensis Lessert, 1930	OWB	12	28	8	-	-	**48**
Nephila inaurata (Walckenaer, 1842)	OWB	16	11	2	-	-	**29**
Totals		**104**	**271**	**81**	**14**	-	**470**
THERIDIIDAE							
Achaearanaea acoreensis (Berland, 1932)	SWB	3	1	-	-	-	**4**
Argyrodes convivans Lawrence, 1937	SWB	7	7	4	-	-	**18**
Crustulina sp. indet.	SWB	1	1	-	-	-	**2**
Phoroncidia eburnea (Simon, 1895)	SWB	1	-	-	-	1	**2**
Steatoda sp. indet.	SWB	1	-	-	-	-	**1**
Theridion sp. indet.	SWB	1	-	-	1	-	**2**
Theridula sp. indet.	SWB	-	1	-	-	-	**1**
Taxa indet. (1)	SWB	12	-	-	-	2	**14**
Totals		**26**	**10**	**4**	**1**	**3**	**44**
THOMISIDAE							
Camaricus nigrotesselatus Simon, 1895	W	-	-	2	1	-	**3**
Diaea puncta Karsch, 1884	W	5	-	1	-	1	**7**
Firmicus abnormis (Lessert, 1923)	W	-	-	-	1	-	**1**
Heriaeus crassispinus Lawrence, 1942	W	-	2	-	-	-	**2**
Pactates compactus Lawrence, 1947	W	3	-	-	-	-	**3**
Paramystaria variabilis Lessert, 1919	W	-	4	-	-	1	**5**
Runcinia flavida (Simon, 1881)	W	7	10	6	-	1	**24**
Synema langheldi Dahl, 1907	W	5	1	-	-	3	**9**
Thomisops pupa Karsch, 1879	W	-	-	1	-	1	**2**
Thomisus blandus Karsch, 1880	W	-	-	1	2	-	**3**
Tmarus cameliformis Millot, 1942	W	-	1	1	-	-	**2**
Tmarus natalensis Lessert, 1925	W	-	-	-	-	3	**3**
Totals		**20**	**18**	**12**	**4**	**10**	**64**
ULOBORIDAE							
Uloborus sp. 1 indet.	OWB	2	16	11	-	-	**29**
Uloborus sp. 2 indet.	OWB	1	3	1	-	-	**5**
Uloborus sp. 3 indet.	OWB	3	3	-	-	-	**6**
Uloborus sp. 4 indet.	OWB	-	4	6	-	-	**10**
Totals		**6**	**26**	**18**	-	-	**50**
Total no. spiders		**789**	**1241**	**724**	**81**	**120**	**2955**
Total no. species		**61**	**56**	**46**	**24**	**35**	**96**